Local Wisdom in Adapting to and Coping with Flood Disaster in ASEAN Countries

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Introduction

The ASEAN region consisting of South-East Asian countries is a culturally rich and rapidly developing region (Siddique & Kumar, 2003). The region has some of the world's fastest growing economies, such as Singapore and Malaysia, as well as some of the world's most culturally diverse countries in Malaysia, Thailand, Indonesia, the Philippines and Singapore (Lallana, 2012). Unfortunately, the region also experiences some of the world's greatest environmental disasters, such as the Asian Tsunami in 2004, massive floods in Thailand (2011) and in Malaysia (2006/2007), typhoons in the Philippines, Vietnam and Cambodia, and volcanic eruptions in Indonesia and the Philippines. Annually, the region is also affected by haze due to a combination of forest burning, industries and urbanisation (Eaton & Radojevic, 2001). In 2011, the focus was on Thailand's massive flooding, but Vietnam and Burma were affected by typhoons (Typhoons Xangsane and Ketsana struck Vietnam in 2006 and 2009, while Burma was battered by Cyclone Nargis in 2008). Amongst the many natural and man-made disasters affecting the region, with the exception of earthquake (which is not considered a major disaster in ASEAN), the most serious disaster (a combination of natural and man-made causes) in the region accounting for the highest number of deaths and greatest amount of losses is floods (Chan & Parker, 1999; Asian Disaster Reduction Centre, 2011).

In terms of disaster management, the main focus has always been on the employment of the structural approach ostensibly due to the belief that science and technology can control nature, including disasters (Kahan et al., 2006). Chan (2002a) deduced that flood management is less than effective due to an over-reliance on structural measures. For example, in Malaysia, the government authority entrusted with managing flood is the Drainage and Irrigation Department (DID) Malaysia, an agency dominated by engineers. Not surprisingly, the major strategies employed by the DID is essentially

engineering-based organisation dominated by engineers. Hence, it is not surprising that structural measures such as construction of flood-control dams, flood barriers, tidal gates, river improvement, river channeling, improvement of urban drainage, and by-pass channels are the norm. In contrast, non-structural strategies such as legislation, flood-risk mapping, resettlement, public awareness and education campaigns, preparedness and adaptation, early warning and evacuation, and other soft measures are given much less attention (Chan, Koh & Aminuddin, 2006). These non-structural strategies have mostly evolved over decades or even centuries, and are considered local wisdom. For example, in tidal floods in coastal areas are largely caused by a cyclone in Southeast Asia. People who have lived long enough in coastal areas with experience of cyclone occurrence and flooding will notice an increase in the ocean swell. About three days before a cyclone makes landfall, the ocean swell typically increases to about 2 m in height with the frequency of waves hitting the shore about every 9 s. This is one of the earliest signs of an approaching cyclone. As the storm gets closer to land, waves will hit the shore with greater rapidity and the swell can increase to as much as 5 m. Communities with local flood wisdom also notice that the wind speed of the storm increases as it approaches land, changing from a weak light breeze (4–6 knots) about 36 h before landfall to a cyclonic storm (34–47 knots) about 24 h before landfall, and eventually into a full blown super cyclonic storm (more than 120 knots) when it strikes land. People can also notice a change in the rainfall pattern. The first rains are light and intermittent around 18 h before landfall, gradually gaining intensity as the cyclone gets close to land. Once on land, it develops into a continual intense downpour that usually leads to flooding.

Nah (2011) documented local wisdom in stockpiling of temporary supplies like water, canned and dried food, tents, blankets, medical supplies and generators to face flood disasters and laments that many ASEAN countries appear to lack well-trained and fully equipped Urban Search and Rescue (USAR) teams, a necessary non-structural measure. Of the ASEAN countries, only Indonesia, Malaysia and Singapore have established official USAR agencies. The Special Malaysian Disaster Assistance and Rescue Team (SMART), for example, has seen action in the west Sumatra Padang earthquake in 2009, while Singapore's Disaster Assistance and Rescue Team (DART) was deployed to Aceh, Indonesia following the 2004 tsunami. Local wisdom to face floods also includes local adaptations, adjustments and responses at the local level to reduce the impacts. In ASEAN countries, local communities in flood-prone areas have learnt to live with floods armed with a variety of strategies, such as changing types of crops, adjusting crop calendar, stockpiling vital commodities, temporary relocation, finding alternative sources of safe drinking water and alternative employment. Obviously, the knowledge at the local level acquired over centuries can be put to proper use if the local people have the capacity

to do so. However, while one may not have much capacity individually, a community approach is helpful. Furthermore, assistance from government and non-governmental organisations in terms of information and supply of certain critical inputs at appropriate times would strengthen the ability of the local people to respond more effectively to flood hazards. But, when a flood affects extensive areas, is of a long duration, and causes large-scale losses and damages, the local responses will still be important but major external assistance from the government and other organisations is needed. Chan (2011) states that traditional wisdom is knowledge that people has gained over a long period of time through direct experience. In contrast, traditional wisdom is wider as it covers not only local wisdom but also universal wisdom. However, in the context of this paper, both terms will be used interchangeably to refer to wisdom in the local context. Local flood wisdom equips the local communities with the uncanny ability to make appropriate decisions to face floods based on local knowledge and experience.

In Malaysian literature, the most famous work about human struggle against floods is that by Shahnon Ahmad (1972). This piece of internationally recognised work is simply about how traditional human peasant society in the 1960s relying upon traditional tools and local wisdom fights for survival against the forces of nature and succeeds in passing on the knowledge and wisdom of past generations to future generations. Despite failures and defeat without using modern knowledge and methods, the message of traditional wisdom holds strong (Chan, Narimah & Suriati, 2013). Arguably, high-tech methods, when applied properly can be effective in ensuring effective water supply, good quality water, and reduce injury and loss of life, loss of livestock, loss of crops and property damage. However, the application of high-tech solutions can only be successful if the public/victims respond effectively to water emergencies, such as drought, El Nino, water rationing, flood warnings and react positively (Chan, 1995a). Often, sophisticated (imported) flood warning and evacuation systems are alien to the public who are accustomed to traditional systems. This will eventually lead to lack of confidence in the costly new technologies, rendering them utterly useless (Hewitt, 1983). In many cases, such confusion and mistrust of the new systems have even led to greater flood loss. In contrast, traditional methods have been employed for centuries and the locals understand them well, as they are used to them. Because of their long adaptation, locals respond effectively in times of flooding via traditional systems, significantly reducing flood loss (Chan, 1999a). This paper examines the rich spectrum of local wisdom on flood management, emphasising the importance of traditional techniques and strategies, and how these can be integrated into the official flood management systems. Local knowledge gives people a sense of confidence to face floods. Without local knowledge, people are less resilient and over-rely on the government flood aid. The best option

for effective flood management would be a combination of both official flood strategy reinforced with traditional flood management systems working in tandem. In this way, the benefits of flood management can be maximised and local wisdom get transferred down for generations.

The methodology used in the research for this paper is largely based on secondary data collection via published data and reports. Secondary data via a literature review of flood hazard research in the ASEAN region in relation to local wisdom and local adaptation are also used in the discussion. Other secondary data include research reports, journal articles and other reports on flood hazard management and mitigation. However, the authors have decades of experience in flood research and used their extensive experience and knowledge in the field by summarising the results of over two decades of research in flood management. The researchers also use in-depth qualitative face to face interview sessions conducted with key informers, such as government flood management officers, important stakeholders, such as village heads and other local leaders, police officers, NGO leaders, local villagers and residents, researchers and land owners. This involved a study on the rich flood experiences of the respondents. Some of the salient stories of the respondents' success stories in adapting to floods via local wisdom were selected and examined.

Flood Wisdom in the ASEAN Region

There are many examples of local flood wisdom, and some have survived the test of time. ASEAN countries, including Malaysia, Thailand, Indonesia, the Philippines and countries along the Mekong River have a long history of flooding. Equally, these countries have also developed traditional wisdom in flood management. Local flood wisdom is the local community's capacity to anticipate, cope with, resist and recover from flood hazards. Such wisdom strengthens a community's adaptability, resourcefulness, resilience and recovery. Many communities in ASEAN countries have lived with floods for centuries and have evolved many strategies to reduce and to mitigate against flood hazards. Generally, the more resilient and innovative ones (in terms of adaptations) are less vulnerable because they have greater flood wisdom. Those with less wisdom in the face of floods are unlikely to survive and would migrate elsewhere or reduced to living in poverty. In the case of Malaysia, Malaysian communities living on floodplains have evolved many adaptations and have learnt to respond positively towards flood hazards. For example, the Malays traditionally have better flood wisdom as they have lived in flood-prone areas for centuries compared to ethnic Chinese and Indians (Chan, 1997a).

Local flood wisdom can also be found in agriculture. During the rainy season, seasonal flooding is used intelligently by local communities in most ASEAN countries, with the exception of Singapore and Brunei, for successful paddy cultivation. The entire paddy farming cycle from sowing to harvest evolves around the monsoon season. When the rains come, sowing starts and when the rains stop, it is time to let the crop ripens for harvest. This is good sense of local wisdom. In Thailand, paddy crop is sowed during the beginning of the Southwest Monsoon from May to September which brings the rains. During the Northeast Monsoon from November to March, Thailand and much of Myanmar experience the dry season. Hence, during this season, dry crops such as tobacco and maize are cultivated instead of rice. In Malaysia, however, the Northeast Monsoon is the wet season bringing heavy rains in November and December. These two months are typically the sowing period of the rice crop in Malaysia. Such local wisdom has allowed local communities to thrive in all these ASEAN countries for centuries. With the introduction of irrigation, however, rain-fed paddy cultivation is no longer of significance. Nevertheless, for many rural areas without irrigation, such local wisdom still applies (Jongdee et al., 2006; Mohammed Mainuddin, Kirby & Hoanh, 2013).

While paddy farming benefits from seasonal flooding which brings rains and soil nutrients, flooding is in contrast controlled by paddy farming. Paddy fields absorb a huge amount of water and are retention ponds for rainfall (Figure 1). In rural villages, especially where paddy farming is the main occupation, local communities realise that their farming lots or paddy fields retain flood waters and controls the rise of the river level. In turn, this controls flooding. However, land use change from converting paddy fields to housing areas or urban settlements has a devastating effect as flood waters can no longer be retained. Hence, in many peri-urban areas where paddy farming has given way to urbanisation, flooding has increased significantly (Sathiamurthy & Chan, 2006). Sathiamurthy, Goh and Chan (2007) found that loss of storage areas, particularly paddy fields, due to rapid urbanisation at the upper Rambai River has totally changed the hydrological characteristics of the Rambai Valley in Penang, resulting in severe flooding. Another related local wisdom is that smart farmers locate their paddy fields at a lower elevation than the land on which houses are built. This not only allows more water to flow into paddy fields, but also ensure that houses will be the last to be flooded. Fields are also located on the lowest land for the purpose of irrigation. Hence, when the rivers overflow their banks, paddy fields act as a form of retention ponds. School fields, fish ponds and man-made lakes are all forms of traditional retention ponds employed by villagers long before engineers-designed artificial retention ponds were used. For example, in the state of Kedah in Malaysia, which is the 'rice bowl' of the country, thousand hectares of paddy fields act effectively as retention ponds to reduce the risk of downstream flooding. In Thailand, paddy

fields also act as retention ponds. During many recent floods, the Kingdom of Thailand had ordered that levees upstream of the Chao Phraya River be broken to allow excess water to flood the royal paddy fields in order to avert flooding downstream. Irrigation canals along the paddy fields also provide a form of diversion and drainage of excess water from the main river. Paddy farming in the form of terracing is another form of traditional wisdom. Terracing reduces the speed of water flow down slopes and reduces soil erosion significantly. This prevents sedimentation of rivers and controls flooding. All over the ASEAN region, one can see terracing being practised. Some examples are in Bali, Indonesia and in Sapa, Vietnam.

Figure 1 A paddy field acts as a huge retention pond for rain and flood waters

In ASEAN countries, flood plain occupants have rich flooding experience and have developed local flood wisdom that are well adapted to floods. Forest conservation is also a local wisdom that has reduced, if not controlled flooding in many rural areas in the ASEAN region. Unlike urban areas which experience greater frequencies and magnitudes of floods, rural areas with local wisdom on forest conservation have managed to control flooding via using natural systems (Chan, 2003; Booij, 2003) found that maintaining forest ecosystem and reforestation is a key towards successful flood mitigation. For good measure, Vietnam has used mangrove reforestation to considerably reduce the impact of flood on coastal populations (Buffle, Nguyen & Thomsen, 2011). In Thailand, destruction of mangrove forests reduced their coverage from 368,000 ha in 1961 to 240,000 ha in 2002 due largely to timber and charcoal industries, urbanisation, agriculture and aquaculture (World Resources Institute, 2007).

This was ironical given the fact that Thais living in coastal areas have local wisdom on what mangroves can provide. Following the devastating effects of the Asian Tsunami in 2004, there was a revival in mangrove reforestation, both by local communities and by the Thai government. The reforestation programme not only increased the hectarage of mangroves for tsunami protection but also for protection against storm surge, as well as increased the capacity of locals in community forestry management, and the building of partnerships between locals, the government and NGOs.

Local early warning systems are considered also a form of local flood wisdom. Yet, most ASEAN countries, especially the advanced countries typically employ state-of-the-art technological systems, such as remote sensing satellite forecasting, real-time telemetry and automatic warning sirens in early flood warning systems and evacuation systems (Chan, Narimah & Suriati, 2013). Undeniably, these advanced systems have saved lives and reduced damages, but they are top-down and hardly involve the stakeholders. Early warning must be understood clearly by the stakeholders if they are to be effective. When stakeholders are not well-informed about these systems, they may not respond effectively to flood warnings. The literature has indicated that imported foreign flood warning and evacuation systems (FWESs) are totally alien to local communities who are accustomed to traditional FWESs. Misunderstanding and scepticism of foreign systems may lead to lack of confidence and uncooperative responses. Chan (1995b) noted that mistrust of the foreign systems have led to confusion resulting in greater flood loss as in several cases of mistrust of the solar sirens in George Town (Penang State) and Kampong Dato' Keramat (Kuala Lumpur). However, if foreign systems are integrated with traditional FWESs that have been employed for centuries, local communities will have better understanding and respond effectively. While the foreign early warning systems, no matter how sophisticated, will never be able to totally replace traditional systems which have developed over a long period of time according to local flood characteristics (Chan, 1999b). In Malaysia, local communities living in floodplains are accustomed and well-adapted to floods. These riverine and floodplain communities have developed local flood wisdom in the form of traditional adaptations and responses to reduce the effects of flooding.

ASEAN also has a unique type of house that is not often seen in other parts of the world. This is the stilt house or buildings erected on stilts. According to Davis (1983), "Disasters often act as agents of change" as people gradually develop innovations in flood-resistant architectural and construction designs. In the ASEAN region, probably the most unique adaptation that has evolved in response to flood disasters is the stilt house (Figure 2). Historically, the stilt house probably evolved as an adaptation to the occupation of swamp land and frequent flooding in riverine/coastal areas (Chan, 1997b). This permanent

form of flood proofing is still predominant in the traditional rural areas where frequent flooding is prevalent. Another common form of traditional adaptation is that of 'clustered houses' joined by wooden walk-ways which are stronger against fast river currents during flooding. The clan jetty villages in Penang, exact sites of early Chinese settlers in Penang, are a good example of traditional local wisdom against flood hazards.

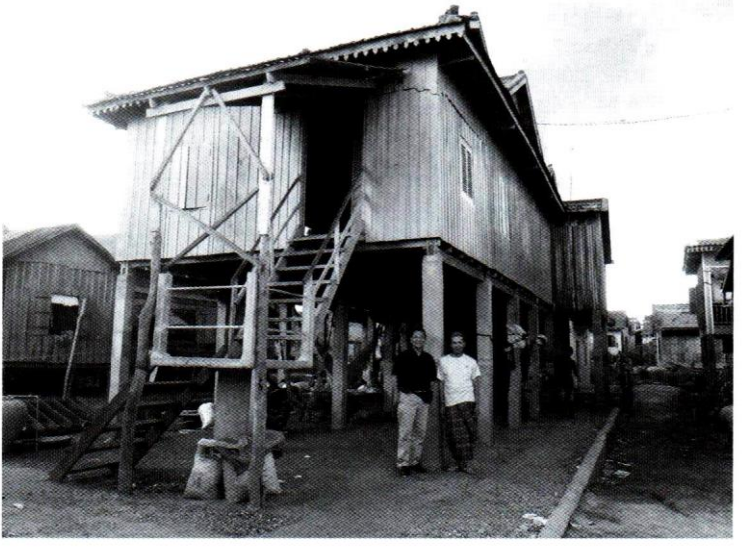

Figure 2 The stilt house has no problems with floods

Much like the stilt house, the 'raft houses' is another unique form of traditional architectural adaptation to flooding (Figure 3). These houses are built on rivers and they rise and fall according to the river level. These houses are so unique that tourists are now attracted to them. Hence in many ASEAN countries, raft houses are used as a form of tourist attraction. In Royal Belum State Park in Malaysia, raft houses are used as hotels to accommodate tourists. These houses can be towed by a boat to various tourist spots in the lakes inside the park. Boat houses are another form of local wisdom evolving from having to live in a water environment. In Cambodia, on the fringes of the Tonle Sap Lake, there are villages built on boats. Hence, there are floating schools, floating restaurants, floating hospitals, floating markets and even floating churches (Figure 4). Floating markets in Thailand have long been a form of local wisdom that is now further developed into a tourist attraction (Figure 5).

Some traditional Malay houses are in fact 'portable'. In Kelantan state in Malaysia, some villages have wooden houses that can be carried and moved like a sedan chair. During the dry months, these houses are located near to rivers for accessibility but during the monsoon months (November to March),

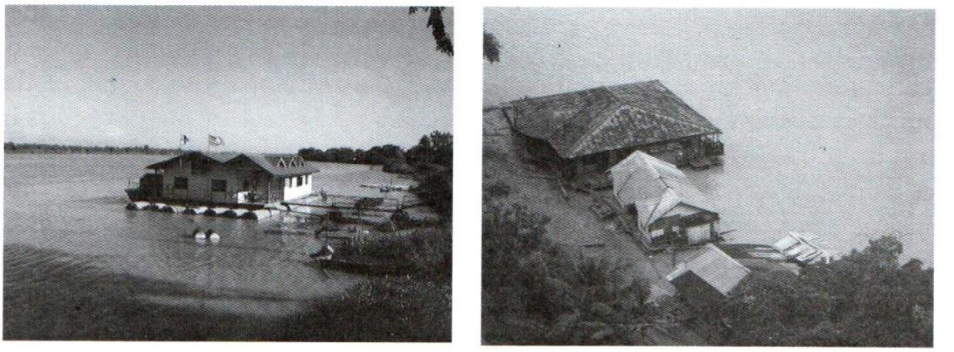

Figure 3 Raft houses along the Kelantan River in Malaysia

Figure 4 A floating church in Tonle Sap Lake in Cambodia

Figure 5 A floating market in Thailand

for accessibility but during the monsoon months (November to March), they are moved to higher grounds to prevent flooding. Other traditional forms of architecture built to defend against flooding are as follows: the raising of the floors by successively building higher levels over existing ones; planting trees in front of houses to reduce the impact of river currents during flooding; piling tree trunks along erosive banks of rivers, also to reduce impact of river currents; building annexes and livestock barns (e.g., chicken coops) in the path of river currents; canals are also a form of adaptation; and concrete or cement flood barriers surrounding houses (including thresholds at the doors) can prevent moderate flooding.

Another unique flood wisdom developed by locals is the 'traditional flood gauges' for monitoring river levels. Monitoring is essential for decision-making with regard to issuance of flood warning and evacuation notices. In Kuala Krai town in Kelantan state in Malaysia, local communities have built a series of steps from the bank of the Kelantan River all the way down to the river. The steps are necessary for people who need to get down to the river and into boats. More importantly, the steps are fitted with stick gauges all the way from the top step right down to the lowest step. These steps were originally called the Bradley Steps, but are now well known as the *Tangga Krai* or Krai Steps (Figure 6). These steps were previously made of clay and hardened sandstone but have now been replaced by more permanent concrete. The villages can read the level of the river simply by noting the number of steps inundated by the river. Through past experiences, a certain critical level whereby flooding is most certain to occur is determined. This step at which this critical level is reached is painted red. Currently, the steps are also used to gauge the river level at Kuala Krai which is in turned used to forecast the river level at Kota Bharu which is 100 km downstream.

Building on the highest locations on floodplains is another traditional wisdom of locals. For example, most villages are built on levees or bunds. These are the highest points along rivers as they are higher than the floodplain. Without such local wisdom, houses built anywhere on the floodplains are more likely to be flooded. In December 1996, tropical cyclone Greg brought heavy rains which flooded Keningau in Sabah, killing 270 people and destroying 5,000 houses built inside the river channel. Ironically, few of these houses belonged to locals as most of them were houses of illegal immigrants from the neighbouring countries (Chan, 2002b). Locals who had lived in the area long enough would have the wisdom not to build their houses within the river's channel. The landless immigrants did not have this wisdom and many were forced to do so as they had little choice.

Figure 6 The Krai Steps a flood warning structure

Conclusion

The ASEAN region is a naturally flood-prone region due to its geography, climate and monsoon influences. Cultural preferences and the need for a livelihood have also influenced people to live on floodplains. In recent decades, as the region develops, rapid development and urbanisation amidst climate change have exacerbated flood hazards. A largely top-down government-centric approach favouring structural flood control measures that did not involve stakeholders have also limited the effectiveness of flood mitigation. Consequently, floods have become more severe in recent decades as population increases followed by climate change. All these were combined to ensure flood hazards remain to be a big issue facing ASEAN countries, despite huge amounts of funds being spent on flood mitigation. This study has shown that flood management in the region is still largely focussed on structural measures whereby governments of the region try to 'control' floods. Such measures have their limitations, one of which is the ignoring of traditional or local flood wisdom, a non-structural measure. In order to ensure more effective flood management, local flood wisdom needs to be incorporated into official government flood strategies in order to significantly reduce exposure, vulnerability and losses. Flood hazards are expected to intensify as urbanisation and rapid development accelerate in future as climate change

intensifies. ASEAN governments need to re-examine their flood management strategies via the introduction of a comprehensive approach combining both structural and non-structural strategies, as well as incorporating traditional coping wisdom into the governmental strategies. Equally, the stakeholders (victims) must be actively engaged and their capacities built via public education and awareness programmes. ASEAN governments should seriously take a look at existing local wisdom held by local communities as these strategies have withstood the test of time. Such wisdom has been gained through great sacrifices and costs. More importantly, they have been effective. If not, they would have been discarded. Local flood wisdom and traditional methods have been employed for centuries and the locals understand them well, as they are used to them. Because of their long experience, locals adapt, use and respond effectively when living with and facing floods, significantly reducing loss of life and economic losses. The rich spectrum of local flood wisdom documented forms an important archive on traditional flood management techniques and strategies. Currently, most governments have not considered using or adapting local wisdom to government flood management strategies. Integration of local/traditional wisdom with modern/technological applications is the key towards more effective reduction of flood impacts. This can be termed integrated flood management, and this approach would involve scientific advancements as well as age-old local knowledge/wisdom.

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